Microeconomic foundations for Goodwin's real wage function

Giuseppe Mastromatteo*

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Abstract **-**The aim of the paper is to investigate the literature on the relation between wages and employment in order to shed light on the economic meaning of the inverse relation between the rate of unemployment and real wages used by Goodwin (1967) in his growth-cycle model. This relationship can be considered a sort of Phillips curve in real terms. After describing the properties of this relationship we considered five alternative microfoundations for it. (i) A first group is based on job search theory, initiated by Alchian (1970) and Hines (1975); these works lead towards an *inverse* relation between employment and real wages. (ii) A second group is based on Kalecki's analysis, where the determination of real wages is the result of social conflict. This setting gives rise to a *direct* relationship between employment and real wages, unlike job search theory. (iii) A third group is based on the idea of social conflict supported by Rowthorn (1977); a fourth group is based on the NAIRU theory presented by Grubb, Jackman, Layard (1982). The common feature of both these approaches is the evaluation of equilibria in imperfect competition. They have been jointly used by Carlin and Soskice in a macroeconomic model consistent with Goodwin's analysis. (iv) Another microfoundation is based on efficient bargaining of wage levels between firms and unions (*right-to-manage* model). These models recall Goodwin's real wage curve, showing how wage movements can affect income distribution; given the expected price level, the resulting wage is related to a real wage expected by the unions. All this leads to a *decreasing* relationship between the unemployment rate and the target wage of the unions. (v) A fifth microfoundation is based on the notion of *efficiency wages*. These theories point out that lower unemployment raises real wages and labour productivity, leading to higher growth (Shapiro and Stiglitz, 1984). A critical evaluation of all these attempts is proposed.

Summary *

* Università Cattolica del Sacro Cuore (Milano). Corresponding address: Giuseppe Mastromatteo, Università Cattolica del Sacro Cuore, Largo Gemelli,1, 20123 – Milano – (Italy), phone: +39-02-72342442 (or +39-02-72342976); fax +39-02-72342781 (or +39-02-72342406); e-mail:giuseppe.mastromatteo@unicatt.it

The aim of this research is to investigate the existing literature on the relation between wages and the employment rate in order to find theoretical foundations for Goodwin's hypothesis (1967) of an inverse relation between real wages and the unemployment rate, from a Phillips curve point of view. First of all we focus on the microfoundations of the labour market equilibrium which arise from Phillips (1958)[1], trying to shed light on existing microeconomic approaches in the framework of economic growth and especially Goodwin's model. The idea of a microfoundation recalls two different assumptions: (1) economic agents always act rationally to maximise their utility and (2) in a long-run equilibrium, agents' expectations are always fulfilled.

We will therefore review the literature resulting from Phillips' work in the light of Goodwin's model, focusing mainly on: the relation between growth and income distribution; the role played by class conflict, with workers willing to maximise their utility function through the unions and employers aiming to maximise their profits; the importance of wages in real, and not nominal terms; market movements outside equilibrium conditions and, finally, the role of technological progress in the case of increasing returns, neglected in most of the existing static analysis.

We briefly summarise the theories analysed and the related results: first of all we evaluate Goodwin's *real wage curve*, stressing the relationship between employment and the rate of growth of real wages. We then examine the view held by mainstream economists, who expound the Phillips curve through the *job search* theory and assume that in the long run the labour market reaches an equilibrium of perfect competition. Thanks to Hines's (1971) interpretation of Alchian's (1970) *job search* theory, we show that the latter is unsuitable if considered within Goodwin's analytical framework, both because it interprets the Phillips curve in nominal terms and because it states a negative relationship between real wages and the employment rate. Moreover, *job search* theory assumes a negatively sloped labour demand curve. In this context the adjustment on the labour market takes place through a fall in real wages. Both these conclusions conflict with Goodwin's.

We next focus on a second microfoundation that recalls Kalecki's theory of real wage as a result of the class struggle (an idea influenced by Marx's reserve army). This formulation – Marx-Kalecki-Goodwin – conflicts with job search theory, as evidenced by Khan (1980). This author, by comparing Kalecki's concept of bargaining power with job search theory through an empirical analysis for the US, ultimately gives more credit to the former.

In the years since then, the Phillips curve has been discussed in two different analytical contexts: the first focuses on the idea of social conflict supported by Rowthorn (1977); and the second one on the NAIRU theory and , in particular, on Layard, Nickell and Jackman's contribution (1991). It is the joint analysis of these two streams, both applied in a context of imperfect competition, that leads Carlin and Soskice to propose a model coherent with Goodwin's idea of a negative relationship between the unemployment rate and real wages, with the same direction of causality. This model, however, is not immune from drawbacks: it does not present any microfoundations.

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*Our paper, arising in the framework of the COFIN project, presents some preliminary results from broader research under way with Prof. Mario Biagioli from the University of Parma.

[1] There is a vast theoretical and empirical literature discussing the paper by Phillips (1958), in which he made the percentage variation in monetary wages depend on the unemployment rate. The empirical relationship identified in this paper was immediately used by the authors of the so-called "Keynesian synthesis" to extend the model set up at the time for labour market and aggregate supply analysis. In this guise, the Phillips curve was applied to comparative static analysis and gave rise to an ongoing debate on the two traditional problems between Keynesians and neoclassicists: the neutrality, or otherwise, of money and the nature, voluntary or involuntary, of unemployment. The problem of the microeconomic foundations of the Phillips curve developed within this analytical conflict.

Finally we shed light on two other possible microfoundations: bargaining models and efficiency wage models. Bargaining models theory focuses on the bargaining process between firms and unions, both through efficient bargaining models, where unions and firms bargain both on wages and level of employment, and right-to-manage models, where bargaining focuses only on monetary wages, while the employment level is set unilaterally by the employers once the wage is bargained. These models seem appropriate for Goodwin's real wage function; moreover, the right-to-manage model confirms Goodwin's idea of a relation between the unemployment rate (as a proxy of bargaining power) and income distribution: given the expected price level, the bargained nominal wage is related to the level of the real wage expected by the union, which represents the union's target during the bargaining process. Consequently, the inverse relation between the unemployment rate and monetary wage is due to a similar inverse relation between the unemployment rate and the "target" real wage that unions seek to achieve.

The basic hypothesis of efficiency wage models is that a rise in real wages increases workers' effort and hence their productivity, albeit asymmetric information on workers' productivity. The cycle is as follows: the fall in unemployment increases real wages and hence labour productivity, reinforcing the effects of expansion phases in the cycle. In Skott (1991) the use of efficiency wage strategies by the firm's management leads to a long-run equilibrium with real wages as an inverse function of the unemployment rate. Skott considers only the case of symmetric management strategies, with all the firms adopting the efficiency wage solution, while hypotheses of asymmetric strategies have not yet been taken into account in the literature, but could prove much more interesting for our purposes since they influence income distribution. For example, if we adopt Shapiro and Stiglitz's hypothesis (1984) that an increase in workers' effort is positively related to the fear of unemployment, when the economy approaches full employment and a larger number of firms adopt efficiency wage strategies, the relation between wages and effort disappears, effort and productivity decline, and hence the economy enters a recession.

1. Goodwin's real wage curve

Although the core of this research is not Goodwin's model itself but its microfoundations, it is worth recalling the model's main features. Goodwin uses two dynamic equations to explain growth cycles. The dynamic of the model recalls the differential equations of Lotka-Volterra's prey-predator model, with distributive conflict leading to a cyclical solution in the share of income to the labour force and in the employment rate.

The core of Goodwin's cycle is the conflict on income distribution, and it is commonly believed to ensue from Marx's theory. The model considers an economy with the following features: a fixed coefficient in the aggregate production function and exogenous rate of technological progress; capitalists invest all profits in capital stock in order to increase both production and demand; while workers consume all their income, leading to a corresponding rise in demand. The cycles in the model arise from the existence of high profits that increase investments, capital stock and employment. The latter leads to higher real wages by means of a "real Phillips curve"-type mechanism. By consequence, lower profits and investments and declining growth rates boost unemployment, leading to the initial conditions of lower wages and favourable conditions for increasing profits and investments.

The causal relations between production and labour market variables highlight the important role of conflict between workers and capitalists. The bargaining power of each party is directly related to the employment rate: the higher the level of employment, and the closer the market is to full employment, the higher will be the pressure from workers' unions. By contrast, at a lower employment level the capitalists have the upper hand in the bargaining process.

Goodwin's labour market presents, however, peculiar features: higher real wages *w* drawing nearer full employment; a constant rate of growth of labour force (*N*); no full employment hypothesis, and consequent possible excess of labour supply (*N*>*L*); no rigidities. Moreover, wage is relatively elastic variable.

Proceeding along lines set by Boggio (2003), the real wage curve can be written as:

$$g_{w/y} = H[1 - (L/N)] - \lambda \qquad [1.1]$$

where $g_{w/y}$ is the rate of growth of the real wage share of income, calculated as the difference between the real wage growth rate (*H* in our equation) and the rate of growth of per capita income, λ.

The second differential equation is:

$$g_{L/N} = g_K - \lambda - n \qquad [1.2]$$

with $g_{L/N}$ equal to the rate of growth in employment (employed workers/labour supply); g_K represents the capital rate of growth (equal to the rate of growth in labour demand with constant productivity, for the hypothesis of fixed coefficients, and to the rate of growth in product, given the constant capital/product ratio); λ is the growth rate of per capita income and *n* the growth rate of labour supply.

Solving the system of differential equations for *w/y* and *L/N*, we obtain a cycle around a steady-state growth path determined by the natural rate that arises from the distributive conflict between workers and firms: when the share of profits exceed the rate of product growth, capitalists increase investments, leading to higher capital stock and higher labour demand. The increase in employment raises real wages more than per capita income and reduces the profit share. Therefore employers will cut investments and labour demand until the rate of growth in real wages is once again lower than per capita income growth; profits expand and the cycle reproduces itself.

2. The Phillips curve according to "job search theory".

It is useful to recall that Phillips' analysis in 1958 was merely empirical and it was only in 1960 with Lipsey's contributions that initial attempts were made to insert such empirical regularities into a theoretical framework, followed by Samuelson and Solow's (1960) stress on the usefulness of the Phillips curve in macroeconomic policies.

The debate on the Phillips curve has its starting point in these contributions. Nowadays, almost 50 years after Phillips' contribution we can confirm Desai's thoughts: "since the publication of the original article (Phillips,1958) the relationship has been modified in many ways" but "despite all this activity, many issues remain unsettled" insofar as "much of the work done since Phillips' paper has been based on a misunderstanding of the original relationship" (Desai, 1975, pp.1-2). Phillips pursues his goal by estimating the logaritm of the following function by using data for the period 1861-1913:

$$dW/W + a = b.U^c \ , \qquad [2.1]$$

where *dW/W* is the percentage annual variation in individual wages, U is the unemployment rate; *a*, with a negative sign, is a coefficient arbitrarily set to determine the position of the curve; *b* and *c* are coefficients estimated with the ordinary least squares method and have the expected signs: positive and negative respectively. As stated by Desai (1975), Phillips' procedure has to be read, and makes sense, only in a long–run horizon; this is why in the original contribution equation [2.1] is estimated on the average values of the six cycles found in the period, without adding any exogenous variable, neither the per capita income level nor the rate of change of unemployment – which were, however, considered in the author's theoretical analysis and in his data description.

To be precise, from 1913 onwards Phillips dropped the observations for the war years and for the years following major increases in import prices and, considering two sub-periods (before and after World War II), he compared the *scatter diagram* of annual observations with the estimated curve in the first period, noticing in the period 1948-1957 a similar trend between the two and concluding that "the statistical evidence supports the hypothesis that the rate of change of money wage rates can be explained by the level of unemployment and the rate of change of unemployment. These conclusions are of course tentative. There is need for much more detailed research into the relations between unemployment, wage rates, prices and productivity" (Phillips, 1958, p.299).

Lipsey (1960) and Samuelson-Solow (1960) re-proposed Phillips' work within a neoclassical theory framework, and identified the equilibrium when the unemployment rate tallies with invariant wages (in this equilibrium, obviously, labour demand equals labour supply, and the latter, given asymmetric information, is equal to the difference between vacancies and unemployed; unemployment is therefore *involuntary* or, in Lipsey's terms, *frictional*). The authors thus applied their analysis to the short run, both in equilibrium and non-equilibrium conditions. It was their contribution that would fuel the debate in the years to come: mainly in the neoclassical mainstream, research has focused on the investigation of the microeconomic basis of the Phillips model in a framework of perfect competition. This aim was mainly justified by the fact that Phillips' evidence for a negative trade-off between unemployment and wage rates clashes with mechanisms operating in a perfectly competitive labour market. With well-behaved production functions (with decreasing marginal productivity that leads to a unique and stable equilibrium) labour demand is inversely related to the real wage and to have a rise in employment there must be a decline in real wages.

It was thanks first to Friedman (1968) and later Alchian (1970) that, through the job search model,[2] the theory overcame the above-mentioned inconsistency. Job search theory applies the idea of workers' errors in forecasting price dynamics with a negatively sloped labour demand curve, but preserves the hypotheses of perfect competition and involuntary unemployment.

According to the job search model only if workers agree on cuts in real wages can increased demand lead to higher employment. This can happen if firms react to the higher demand by offering increasing nominal wages, followed by a greater increase in prices, until real wages equal labour marginal productivity. The labour force, by contrast, because of a "money illusion" effect, mistakes the rise in nominal wages for a rise in real wages and expand their labour supply. Hence the higher labour demand causes higher supply and the market reaches the equilibrium state which is, obviously, a temporary equilibrium since as soon as workers realise that real wages are unchanged – or have even declined - they will try to negotiate increments in nominal wages, with a consequent rise in real wages and labour supply. Prices and wages will therefore chase each other, fuelled by the adjustment of expectation to past inflation, that will continue until the economy enters a period

[2] The idea that job search could be one of the main causes of friction in the labour market was initially proposed by Phelps (1968), Alchian (1969) and Mortensen (1970a and 1970b). Recentely this idea has been resumed and formulated rigorously by Pissarides (1990 and 2000).

of deflation and the level of unemployment removes the inflationary expectations of the previous period.

We can summarize Alchian (1970) analytically, starting from the equilibrium equation of the labour market:

$$L^d\,[W/P;Y] - L^s\,[W/P;Z] = 0 \qquad [2.2]$$

where L^d is labour demand, a decreasing function of real wages (W/P) and increasing function of aggregate demand (Y); L^s is labour supply, an increasing function of real wage and of a vector of variables, Z, that describe labour force behaviour, the reserve wage, and the union's ability to achieve positive results from bargaining.

When labour demand increases and, by consequence, real wages rise, the market moves from the equilibrium:

$$d(W/P)/(W/P) = \Lambda\,[(L^d - L^s)/\,L^s] = \Lambda\,(-\,U) \qquad [2.3]$$

where Λ measures the speed at which the market adjusts to disequilibrium. Any variation in $[(L^d - L^s)/\,L^s]$ leads to variations in the rate of unemployment in the opposite direction. Market movements can be summarised as follows: a fall in unemployment rate U lowers wages, both in nominal and real terms (prices are unchanged so far); if labour productivity were to remain constant (and the labour demand curve did not shift) in a perfectly competitive market, profits would be negative.

This is the *impasse* that neoclassical theory was facing in its attempt to study labour market movements by means of the Phillips curve. Their solution was to distinguish between the factors that affect wages and those that affect prices, relating the first to the unemployment rate (as in the original Phillips curve) and expected inflation, and the second to wage variations and to a measure of the slope of the labour demand curve. This leads to the following three-equation system:

$$d(W/P)/(W/P) = [dW/W] - [dP/P] \qquad [2.4a]$$

by definition;

$$dW/W = \alpha(U) + \beta[dP^{att}/P^{att}] \qquad [2.4b]$$

which represents the so-called *augmented Phillips curve* (Phelps 1970) and relates the changes in nominal wages both to the unemployment rate, through the decreasing function $\alpha(U)$, and to the expected changes in prices, with a positive sign; β is the speed of adjustment of expected inflation to nominal wages;

$$dP/P = (dW/W) + \chi[U] \qquad [2.4c]$$

which relates variations in prices (χ is a positively sloped function) to variations in wages and employment, that shift the equilibrium along the labour demand curve.

According to this model there is a unique equilibrium at which expected prices equal real ones ($P^{att} = P$), and this equilibrium is achieved when the market reaches a level of unemployment that keeps nominal wages constant or increasing at the same rate of increase in labour productivity. This is the point at which the Phillips curve intersects the abscissa axis. The related rate of unemployment is the so-called "natural rate of unemployment" (Friedman's definition), and it is the instrument to overcome the problem that Friedman noticed in the Phillips curve: the relation between a variable in real terms (the unemployment rate) and one in monetary terms (the nominal wage). The equilibrium of the "natural rate of unemployment" is a permanent one, and it takes place when expected inflation equals actual inflation; with rational expectations this happens simultaneously. If the unemployment rate differs from the natural one and agents are not rational the market will reach temporary equilibria characterised by monetary illusion with workers mistaking nominal for real wages.

The model describing this hypothesis can be written in the following reduced form (the dependent variable is the price variation, instead of the variation in wages, to stress the importance of the price adjustment mechanism that adjusts wages to the level consistent with the market equilibrium) :

$$dP/P = [dP^{att}/P^{att}] - \zeta [U - U_N] + s \qquad [2.5]$$

where ζ expresses the effects that the distance between the actual rate of unemployment and the natural one has in terms of inflationary pressure, and vector s represents the supply shocks that affect the level of the natural rate.

However, this microfoundation of the Phillips curve, subsequently extended to cover imperfect competition (through a better analysis of those structural factors that can affect the natural rate of unemployment) and to better specify the role of rational expectations, still seems far removed from Goodwin's statement, due to the core assumption that a fall in real wages is required for a rise in aggregate demand to increase the rate of employment. The idea of workers' erroneous perception of wage increases (they believe that real wages increase even though this is due to the misleading effect of inflation) does not change the conclusion that, in this kind of model, unemployment and wages move along the traditional neoclassical demand curve in the same direction, while Goodwin's model has unemployment and real wage moving in opposite directions.

3. Unemployment and real wages: the bargaining power theory

Marx, with his idea of a "reserve army", and Kalecki, with his contributions in 1939 and in 1971[3]-surely well known by Goodwin, can be considered the first to advocate the importance of "bargaining power" to explain the relationship between unemployment and real wages.

The Kaleckian "distributional cycle" was the first attempt to analyse economic cycles through sophisticated procedures relating dynamics and income distribution. According to Kalecki, investment decisions and actual investments are not simultaneous but they experience a time lag. Moreover, such decisions are driven by the following mechanism of profit maximisation: capitalists obtain positive profits that are reinvested, hence the higher the profits the greater the investments will be. Since profits represent the remuneration to capital, the income distribution between capital and labour is, according to Kalecki, a core element of the capitalistic dynamic. In this sense, Kalecki is a precursor of Goodwin's formulation

[3] The major contributions for the purposes of our contribution had already been published in the 1940s.

The second key factor in Kalecki's analysis is the theory of income distribution. Unlike previous Marxian literature, which focused on the role played by distributive conflict, Kalecki showed that the class struggle was transposed into collective bargaining, affecting income distribution due to the union's bargaining power.

In this view unemployment is a mechanism to control union bargaining power and prevent workers taking possession of the whole surplus in full employment conditions. It is for "political reasons" that capitalist economies do not have a permanent "full employment condition".

Before moving on to examine the more recent contributions on bargaining power, it is worth restating the importance of imperfect competition[4] in this approach. Concerning income distribution, Kalecki's original work assumes constant a mark-up in costs and invariant income distribution between employees and employers. Recent works on bargaining power, especially Boddy and Crotty (1975 and 1976), hypothesise that the degree of monopoly power, and the consequent level of mark-up, lowers in expansion phases, leading to a higher share of wages in income distribution.

In expansion phase, there are, therefore, increases in both nominal and real wages. This point of view is close to Goodwin; his model, indeed, states that employment growth leads to a gradual increase in real wages until it exceeds labour productivity, with a consequent fall in profit share and lower investments. Then a recession phase will follow the expansion phase: higher unemployment and higher profits will lower wages and the cycle will reach a new expansion phase.

An important empirical research by Kahn (1980) - taking back a point already made by Desai (1975) - compares job search theory and bargaining power theory. Using quarterly data for the United States in the period 1960-75, the author estimates the following equation:

$$W - W_{Trend} = a + \Sigma^{2}_{i=0} b_i (1/U_{t-i}) + \Sigma^{2}_{i=0} d_i \Delta U_{t-i} + \Sigma^{2}_{i=0} f_i PRO_{t-i} + \varepsilon \quad [3.1]$$

where $(W - W_{Trend})$ is the difference between the log of real wage at time t and its trend; U is the unemployment rate and $\Sigma^{2}_{i=0} b_i (1/U_{t-i})$ measures the effect of $(1/U_{t-i})$ on the difference between the wage and its trend. The sign of the summation determines which of the two theories better fits the empirical data. According to bargaining power theory a rise in $(1/U_{t-i})$ increases wages, while according to job search theory lower unemployment requires lower real wages to allow movements along the labour demand curve and an increase in employment. $\Sigma^{2}_{i=0} d_i \Delta U_{t-i}$ expresses the convexity of the Phillips curve; $\Sigma^{2}_{i=0} f_i PRO_{t-i}$ measures the effect of productivity on wages; a and ε are, respectively, the constant and the error term.

Kahn's estimate showed that $\Sigma^{2}_{i=0} b_i$ is statistically significant and positive, which was read by the author as proof that bargaining power theory is a better explanation of the empirical evidence.

4. Social conflict and wage bargaining

In 1977 Rowthorn, on the basis of Kalecki's contribution, sketches a model of *inflation theory based on conflict*, stressing the importance of expected inflation and monetary policy in the augmented Phillips curve, written as

[4] See Backhouse and Salanti (2000) for the difficulties of microfoundations in conditions other than perfect and monopolistic competition.

$$P^{not\ ant} = f\,[Aspiration\ Gap\ (U;\ Distributive\ variables)] \qquad [4.1]$$

where unexpected inflation is an increasing function of the *Aspiration Gap* - the difference between the targeted income share of workers (negatively related to the unemployment rate and the distributive variables) and the actual income - with a positive coefficient if the workers' bargaining power increases, with a negative coefficient otherwise. Equation [4.1] illustrates the conflict on income distribution between firms and workers and states that (1) only *unexpected inflation* has redistributive effects on income and (2) every price variation that leads to income redistribution worsens workers' income share. Class conflict occurs when the profit share negotiated according to a certain level of expected inflation differs from the profit share that capitalists seek to obtain through a settled price strategy, while when the firm's pricing policy coincides with the negotiated profit share there will be no conflict.

In the basic model, conflict occurs between labour and capital, and the ways in which each class can express its bargaining power is affected by market conditions and existing aggregate demand; below a certain level, future inflation cannot be anticipated and thus it will not affect agents' decisions.

When demand rises and unemployment falls, class conflict becomes more intense and inflation unexpectedly increases; workers will not welcome the consequent real wage distribution and their attempts to defend their income share will cause higher inflationary pressure. Rowthorn's model takes into account distributive variables as well, such as taxation and exchange ratios, shedding light on the effects of these variables on inflationary pressure. However, once the market reaches a fixed level of inflation, both capitalists and labour force will be able to anticipate future inflation and the trade-off between inflation and unemployment ceases to exist. This situation leads to explosive hyperinflation that can be stabilised only through a cut in demand and a rise in unemployment until the requirements of both parties converge. According to Rowthorn, therefore, class conflict is caused and regulated by aggregate demand factors.

Further Keynesian analyses of the Phillips curve in the 1980s aimed both to preserve its explanatory power (and even augment it to tackle the stagflation of those years) and to respond to the lack of empirical evidence. Hence some variables were added to the previous model in order to consider the so-called "cost-push" (Layard and Nickell, 1985) and respond to the criticism that expectations had been stressed and exogenous shocks neglected (Bruno and Sachs 1985, Bean, Layard and Nickell 1987).

Using Grubb, Jackman, and Layard's model (1982) – re-proposed by Layard, Nickell and Jackman (1991) – we consider a nominal Phillips curve in the form:

$$\dot{w} = \dot{p}^e - \beta(U - U_0) + \dot{\chi}^e \qquad [4.2]$$

where β is a constant expressing the rate of deceleration of the increase in monetary wages $\dot{w}_t$ when the actual unemployment rate U increases by 1% in relation to the natural rate U_0; $\dot{\chi}^e$ denotes the rate of growth of labour productivity in recent years, but it also shows the required increase in real wages when $U = U_0$. Equation [4.2] postulates that unions negotiate real wages according to both the inflation effect and higher labour productivity. This is a realistic hypothesis given that it is easier for workers to rely on the evidence of past productivity instead of negotiate according to expected productivity growth. Moreover they will be reluctant to agree on lower wage increases compared to those of previous years, even during economic crises[5].

[5] A variant of the model considered here is that which includes not only past increases in labour productivity but also the degree of social conflict to explain the demands for real wage increases. Hence, assuming that workers have vague information about their average and marginal productivity (in this case, afraid of being deceived, they have little

Carlin and Soskice (1990) further develop Rowthorn's idea of social conflict and focus on the distributive conflict in two different stages: (1) wage bargaining between firms and union and (2) firms' price setting. An equilibrium occurs when both mechanisms are satisfied simultaneously. The authors recall models by Rowthorn, Grubb, Jackman and Layard, and move further in the following direction[6].

At first we assume that, through collective bargaining, wages are set as follows:

$$W/P^e = b(u;z) \,.\, (Y/N)^e \qquad db/du<0 \qquad [4.3a]$$

where W is the net labour remuneration, P^e is the expected consumer price index for the period of the contract; b is a function of the outcome of the bargaining process and is negatively related to the unemployment rate (u) and positively related to a vector z of other factors (such as the reserve wage) which denote workers' bargaining power[7]; Y is output, N is the number of employees and Y/N is labour productivity, unknown to the workers during the bargaining process.

Then we assume that firms set prices according to the "full cost" hypothesis:

$$P = (1+\mu) \,.\, [W/(Y/N)] \qquad [4.3b]$$

where $(1+\mu)$ is the mark-up and measures the firms' power in that particular market and $W/(Y/N)$ is the unit labour cost (unlike the workers, the employer knows that output per capita is related to firm size). Prices will be set by adding a fixed mark-up, varying according to the level of competition in the market, to the labour cost, influenced by collective bargaining, each firm's management policy and taxation.

The equilibrium occurs when the following three conditions are satisfied simultaneously: (1) the determined prices equal expected inflation; (2) the level of output per capita settled during the bargaining process equals the actual level of output per capita; (3) real wages negotiated according to equation [4.3a] equal real wages that firms can afford to pay in accordance with equation [4.3b]; it is the change in unemployment rate that shifts real wages in order to reach the equilibrium and satisfy such conditions.

Bargaining power theory could be criticised for the use of an *ad hoc* microfoundation (neither labour force behaviour nor capitalists' decisions are the outcome of a maximisation process, and the model is irreparably macroeconomic) and for the lack of innovation compared to Goodwin's.

Let us have a look at the additional information we can obtain once we investigate the microfoundation of [4.3a] in accordance with the two models of "efficient bargaining" and "efficiency wages". We intend to assess how each of them deals with, or – should it be explicitly handled – how it would deal with the problem of the link between income distribution and

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confidence in the information from employers or the government), the delay in adjusting real wages to productivity changes depends on the degree of social consensus. Thus, the higher the degree of trust between workers and employers, the quicker is the adjustment of real wages to actual labour productivity levels (Alchian and Demsetz, 1972).

[6] Cfr. also Biagioli (2003).

[7] There are several models in the literature that describe the form of the bargaining function. All postulate the negative effect of unemployment on the wage level. As for other factors, the results differ from model to model. For example, Jackman *et al.* (in a model that was not published but was reported integrally in Carlin and Soskice - 1990; Ch. 17.1.1, pp. 414-418 of the Italian edition) identify four factors: the level of unemployment benefits (whose increase reduces the cost of strike action and thus allows greater use of this type of pressure, thereby driving wages upwards); the relative strength of the union (whose increase obviously allows workers to obtain higher wages from bargaining); product demand elasticity (whose increase reduces real wages, in that the employer encounters more difficulty in offsetting the wage increase by increasing prices); product elasticity as regards employment (whose growth increases the reduction of profits resulting from the wage rise and the reduction in employment, driving the firm to oppose more vehemently any wage rise remands).

economic growth in dynamic terms rather than, as such models generally do, within comparative statics.

5. Wage bargaining and the economic cycle

The models that seem to fit the labour market characteristics indicated in Goodwin are union bargaining models, especially *right to manage* models and "efficient bargaining" models. Goodwin's model makes no mention of the trade unions. However, since union bargaining models presuppose that the utility function which is maximised by the union is that of median member of the union, this microeconomic consideration may be right for Goodwin's model, on the assumption that all workers are equal. Union bargaining models also appear pertinent to Goodwin's because they stress the distributional question: the parties actually bargain to share a rent, a surplus. Clearly, with reference to the latter aspect, the market in which the firm has to operate cannot be one of perfect competition. Indeed, if there were perfect competition, there would be no surplus profit and hence not even the preconditions to speak of bargaining.

The need to identify the purpose of union action has generated a large literature. Here we focus on the two main interpretative models: the first is that in which bargaining processes are assumed only on wages (*right to manage* model), the second hypothesizes negotiation both of wages and of employment (*efficient bargaining* model)[8].

The *right to manage* model assumes that the firm and the unions bargain only on wages and that it is therefore the firm that defines the employment level. The concept used by this approach is the generalized Nash solution (hence the axiomatic approach), by which wages are determined by the maximisation of each agent's profit achieved in bargaining, weighed by bargaining power, given the other's payoff.

The result of the generalized Nash bargaining approach may be expressed as follows:

$$max\ (v_1, v_2)\boldsymbol{\Phi} = (v_1 - \underline{v}_1)^{\beta 1}\ (v_2 - \underline{v}_2)^{\beta 2}$$

$$s.t.\ v_i \geq \underline{v}_i,\ i = 1,2.\ \ per\ ogni\ \beta_1, \beta_2 \geq 0. \qquad [5.1]$$

where v_1 and v_2 are the utilities (i.e. the payoffs) that the contracting parties obtain from bargaining. With reference to Goodwin's model, they are the amounts of the product that workers and capitalists share. $\underline{v}_1$ and $\underline{v}_2$ are the utilities (hence payoffs) that their counterparts would obtain if the bargaining process were not successful. We may interpret the last two parameters as the minimum utility that the worker may gain from his/her wage – otherwise there would be zero demand – and as the minimum profit that the firm must obtain. Referring to Goodwin's model, undersigned *v*'s may be seen as the minimum amount of product that the parties are will to accept in the distributional conflict. β_1 and β_2 stand for the bargaining power of the parties involved. In Goodwin's model, this power depends, in turn, on the employment level given that the more employment increases (it might be better to speak of the growth rate of employment), the greater the impact of worker associations.

If the total surplus to be shared is unity, it may be shown that:

$$v_i = \underline{v}_j + [\beta i / (\beta_1 + \beta_2)]\ (1 - \underline{v}_1 - \underline{v}_2) \qquad [5.2]$$

Assuming that the total income to be shared is equal to unity, what is "at stake" is what remains of the product after paying the minimum for factors of production, capital and labour, that is $(1 - \underline{v}_1 - \underline{v}_2)$. Each of the contracting parties is thus paid the minimum plus part of the surplus that depends on their own bargaining power.

[8] In dealing with the above models we refer in particular to Booth (1995).

The payoff that the union seeks to maximise in the bargaining phase is the utility expected of median member of the union[9], that is:

$$EU=n/t\ u(w) + (1 - n/t)\ u(b) \qquad u'(w) > 0;\ u''(w) < 0 \qquad [5.3]$$

where w is wage; b represents outside options; n is the number of employees; t may[10] represent the labour force. Hence n/t is the probability of being employed.

Thus the generalized Nash solution to this problem is:

$$max\ (w)\ B = \{[n/t\ u(w) + (1 - n/t)\ u(b)]\}^{\beta}\ \{pq(n) - wn\}^{(1-\beta)} \qquad [5.4]$$

in which β measures the union's bargaining power; $(1 - \beta)$ the firm's bargaining power.

The solution to this bargaining problem coincides with the point at which the wage level, defined by the union and the firm, makes the marginal benefit that the union obtains from the one unit increase in the wage level – net of the cost for the consequent reduction in employment – equal to the marginal cost that the firm will have to incur for the wage increase, if costs and benefits are weighted with the bargaining power of each party. Following Booth (1995), this can be expressed mathematically as follows:

$$\frac{\beta w u'(w)}{u(w)-u(b)} - \beta\varepsilon = \frac{(1-\beta)wn}{pq(n)-wn} \qquad [5.5]$$

in which $\varepsilon = -n'(w)w/n$ represents the elasticity of labour demand with respect to wages.

This partly differs from the results obtained by the monopolistic union models simply in the term that represents the marginal cost that the firm incurs to ensure a wage increase. This term in the *right to manage* model reflects the fact that wage bargaining takes place between the parties, and the wage is not monopolistically determined by the union. Thus due account must also be taken of the impact of the wage increase upon firm profits.

According to the efficient bargaining model (Leontief, 1946; McDonald, Solow 1981) the union and firm negotiate both on salary and on employment. The resulting output lies on the contract curve. The solution is found by setting a certain payoff level for a contracting party and maximising that of the other, given the first. The solution is therefore not unique, but depends on the payoff level arbitrarily set for one of the parties.

$$Max\ (w,n)\ \Pi = pq(n) - wn$$

$$s.t.\ n/t\ [u(w) - u(b)] + u(b) = \underline{U} \qquad [5.6]$$

In this case the aim is to maximise the firm's payoff, having set a given union payoff level. $q(n)$ represents the product, reasoning, in this case, that the only factor of production is work.

An efficient pair of values (n,w) is given by the equality of the marginal rate of substitution between employment and wages for the union and for the firm, hence:

$$pq'(n) - w = -\ [u(w) - u(b)]\ /u'(w) \qquad [5.7]$$

Therefore, the contract curve is the set of points that satisfy the last equality. To establish where the equilibrium will be positioned along the contract curve it is necessary to set the utility (payoff) of one of the parties and maximise the other's.

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[9] It is assumed that majority decisions are made within the union. Hence the utility maximised during bargaining is that of the median elector. The concept of median very often refers to seniority, that is the number of years accrued as a member of the workers union.

[10] t could also stand for the number of union members in the case in which worker associations were of the closed shop type. However close shop systems in the labour market are hardly ever found any more.

The generalized Nash bargaining solution may also be used in this case to find a particular solution to the bargaining process:

$$max\ (n,w)\ \tilde{A} = \{n/t\ [u(w) - u(b)]\}^{\beta}\ \{pq(n) - wn\}^{(1-\beta)} \qquad [5.8]$$

The solution to this maximisation problem is as follows: the union and firm will set w and n such that the wage equals the sum of the average and marginal product of labour, weighted respectively with the bargaining power of the union β and that of the firm $(1–\beta)$.

As the equilibrium must also be on the contract curve, it will be characterised by:

$$w = \beta pq(n)/n + (1 - \beta)pq'(n) \qquad \textit{rent division curve} \qquad [5.9]$$

$$w = pq'(n) + [u(w) - u(b)]/u'(w) \qquad \textit{contract curve} \qquad [5.10]$$

The last two expressions are the first order conditions for maximising $\tilde{A}$ against w and n.

Equilibrium wages and employment derive from the intersection of the rent division curve and the contract curve. If the union has no bargaining power $(\beta = 0)$ the rent division curve collapses in the demand curve; if the firm has no bargaining power $(\beta = 1)$ the rent division curve becomes the average product of the labour curve.

Using an "efficient bargaining" model, Balducci and Staffolani (2000) gave an explanation of the phenomenon, verified empirically, of the relation existing between the quantity of labour and unemployment, noting that a decrease in the former is matched by an increase in the latter[11]. This brings to mind Goodwin's real wage curve. The authors offer an alternative explanation to that of Goodwin, justifying their choice with a consideration regarding time: the opposite trend of the two variables seems to last too long to speak of "cycle". The reduction in the labour share and the increase in unemployment are thus explained by using an efficient bargaining scheme between employers and unions: the union's bargaining power is the key element in explaining both the labour share and that of employment.[12]

Empirical evidence from Europe (though not confirmed for English-speaking countries) underlines the progressive reduction of the labour share in the product over the years. This has encouraged researchers to concentrate their efforts on a subject that had been overlooked: functional distribution of income.

In Italy, in particular, the labour share in the gross domestic product fell from 70% in 1975 to 50% at the end of the 1990s. A phenomenon which ran almost parallel to the reduction in the labour share was the increase in unemployment. It is therefore worth investigating whether and in what way the two phenomena are linked. For Italy the negative relation between the two variables is statistically significant especially for the period from 1983 to 1998. Balducci and Staffolani address this phenomenon, starting from a static efficient bargaining model so as to identify the determinants that affect the functional distribution of income and, in particular, the labour share. Their paper concludes that the labour share (also when stripped of the effects of composition) and employment levels depend positively on union bargaining power.

[11] In the appendix to the above work, the authors report the results of an attempt to endogenize union bargaining power, later resumed by Marchetti (2002).

[12] A paper based on different underlying suppositions is that of Marchetti (2002), who presents a dynamic model intended to overcome the intrinsic limits in the dynamic models of union behaviour. Compared with previous dynamic models of union behaviour, Marchetti's model places greater stress on the conflictual nature of firm-union relations without placing the firm in a role of merely adapting to union choices. The model recognises the advantages of dynamic over static models but seeks to move forward, also in the sense of endogenising union membership and not leaving it as simply exogenous the labour share in the presence of efficient bargaining.

It emerges that the labour share could depend on different magnitudes according both to the production function used and to how salaries and prices are fixed, and on the fact that firms operate along the labour demand function.

The hypothesis that there is an efficient bargaining process between firms and workers both with regard to wages and employment justifies the existence of differences between marginal productivity and real wages based on the fact that firms retain a surplus since this is imposed by workers (or rather, by their representatives) during bargaining.

The generalized Nash approach, used by the union bargaining models reported, is considered the most relevant to explaining the labour market in Goodwin's model. Indeed, many models of the labour market seek to justify the presence of involuntary long-term unemployment, highlighting wage immobility from various standpoints although the labour supply almost constantly exceeds demand. Moreover, these models have no specific reference to income distribution. The increase and decrease in employment in Goodwin's model do not depend on institutional rigidities but on the conflict between owners of the means of production and workers and on the income distribution there of. The level of profits (hence of investments and employment) depends on the power of capital over labour. Bargaining would control income distribution it were perfectly central. The strength of unions and employers depends on the employment level which is, in turn, a consequence of bargaining both in the right to manage model and in that of efficient bargaining.

It is to be ascertained whether and to what extent the suppositions on the link between real wages, income distribution and the economic cycle made by these two models (right to manage and efficient bargaining) may usefully supplement the analysis begun by Goodwin. To this effect, an attempt could be made to examine the distributive problem with a dynamic (perhaps two-period) bargaining model. This model could capture the output of bargaining in a period with respect to the employment outcome, and change the bargaining power of the parties in the subsequent period. It is as if the *b*'s that measure power during bargaining were not given but may vary in time and, in particular, depend on the bargaining output from the previous period.

6. Efficiency wages

The literature on so-called *efficiency wages* originated from the idea that the wage does not only play the role of price that leads to labour market equilibrium, but also that of incentive for worker commitment. The underlying hypothesis of this literature (conceived by Solow, 1979) is contained in the *effort function*:

$$e = e(w) \text{ with } \quad e'>0 \quad e''<0 \quad \text{(at least for relatively high wage levels)} \quad [6.1]$$

which indicates that the effort made by the worker in the workplace (e) is an increasing function of real wage obtained.

This hypothesis entails a particular formulation of the production function:

$$y=f[n.e(w)] \qquad [6.2]$$

where y is production, which increases with the quantity of production factors used (in the short term the only variable factor of production is the quantity of labour used: n is the number of workers) but also with worker effort, which depends on real wage level[13].

The entrepreneur decides how much to produce, maximising his/her profit function:

[13] The expression inside brackets is defined as "employment in terms of efficiency units".

$$Max\pi = pf[ne(w)] - wn \qquad [6.3]$$

both with respect to w and n.

Assuming conditions of perfect competition and setting prices equal to 1, the following first order conditions are obtained:

$$\frac{\partial \pi}{\partial w} = f'[ne(w)]e'n = n \qquad [6.4]$$

$$\frac{\partial \pi}{\partial n} = f'[ne(w)]e(w) = w \qquad [6.5]$$

Dividing [6.5] by [6.4] we obtain the solution for the equilibrium wage:

$$[e(w_{EQ})]/[e'(w_{EQ})] = w_{EQ} \qquad [6.6]$$

equivalent to:

$$[e'(w_{EQ}).\ w_{EQ}]\ /[e(w_{EQ})] = 1 \qquad [6.7]$$

The expression to the left of the equals sign is the elasticity of the effort function against real wages. The entrepreneur must ensure that is equal to 1 for his/her profits to be maximised (this result is known in the literature as the Solow condition).

Finally, having taken account of the role played by wages as an incentive for worker commitment the entrepreneur conducts his/her maximisation profit strategy so as to maximise wages per unit of efficiency. Wages are no longer able to play their traditional function of balancing labour demand and supply. Thus involuntary unemployment may arise; and this is the point that Solow sought to raise by constructing this model.

Up to this point we have laid the microfoundations of entrepreneur behaviour, not that of workers. To examine the latter, we will use the model by Shapiro and Stiglitz (1984) which describes the way in which the worker decides how much effort to supply in a situation in which he/she cannot be controlled unless the entrepreneur is willing to incur monitoring costs. In this situation the worker may exploit the information asymmetry thus arising (he/she knows the level of effort he/she is producing while the entrepreneur has to maintain a monitoring cost) to gain benefit from it (he/she is in a moral hazard situation).

The worker is assumed to have a utility function:

$$u(w,e) \qquad \text{with } \frac{\partial u}{\partial w} > 0, \frac{\partial u}{\partial e} < 0 \qquad [6.8]$$

such that his/her utility increases with the rise in real wages and decreases with the rise in effort applied to work. The worker has to decide whether it is worth shirking, risking being caught in the act and fired, or working hard.

Let us define as p the probability of the worker being caught shirking and then fired, and let us suppose that, in the event of dismissal, there are two possibilities: find another job with wage $\overline{w}$ (which is assumed lower than wage w paid by the firm in which he/she works; if it were not so, the incentive to shirk would be very high and the firm would have to incur extremely high monitoring

costs) or obtain unemployment benefit *b*. Suppose also that the probability of finding another job is equal to *q*.

In the end, the utility of the worker (u_{lav}) who shirks will be equal to:

$$u_{LAV} = (1-p).w + pz \qquad [6.9]$$

where *z* (the reserve wage of the worker fired) is equal to:

$$z = (1-q).b + q.\overline{w} \qquad [6.10]$$

with *u* the unemployment rate and *q=1-u* the probability of the fired worker finding another job.

Thus the utility of the worker who does not work hard will be equal to:

$$u_{LAV} = w_{EFF} = (1-p)w + p\,u\,b + p(1-u)\overline{w} \qquad [6.11]$$

The firm will thus find it worth paying an efficiency wage w_{EFF} at least equal to the value indicated in [6.11] to convince workers not to shirk: this wage will be a decreasing function of the probability that firm can catch the shirkers (hence of the costs incurred by the firm to catch them) and an increasing function of wages paid by other firms and unemployment subsidies. If, as is necessarily the case so that workers are forced to put themselves on the market, $\overline{w} > b$ the efficiency wage will rise with the reduction in unemployment. As the economy gradually approaches full employment, the premium that the firm must pay the worker to save monitoring costs rises, since the disbenefit of the worker caught shirking is reduced, in that he/she, in the presence of a favourable labour market, would find another job more easily.

For the purposes of the problem in hand, the theory of efficiency wages supplies two indications: (1) the production function depends not only on the quantity of factors of production but also, with a positive sign, on worker effort which, in turn, depends on wage level; (2) the premium that workers require to work hard increases with the decrease in unemployment.

The efficiency wage model has already been used by Skott (1991) to provide a microeconomic basis to Goodwin's model, reworking the Marxian idea of an industrial reserve army in terms of the efficiency wage and specifying the effort function [6.1]:

$$e = w_{eq}^{\gamma} \qquad [6.12]$$

(in which γ is the coefficient that links real wages and worker effort, a sort of elasticity of worker effort with variations in real wages) and obtaining, in the event of all firms adopting the strategy of efficiency wages in similar fashion, such that real wages are the same in each, the following long-term equilibrium solution on the labour market:

$$w_{eq} = \left[\frac{u}{(u-\gamma)}\right] z = h(z;u) \qquad \text{with } \frac{\partial w_{eq}}{\partial z} > 0 \text{ and } \frac{\partial w_{eq}}{\partial u} < 0$$

[6.13]

which configures a negative relation between the unemployment rate and the equilibrium wage (depending on the elasticity of worker effort, γ, and the reserve wage that workers may obtain should they remain unemployed, *z*).

Assuming, as does Goodwin, that the capital use rate is constant, that the production function has set coefficients and that profits are completely reinvested, Skott examines the relation between employment and income distribution as follows. The profit rate (π) is given by the expression:

$$\pi = \frac{py - pw_{eq}n}{py} = 1 - w_{eq} \cdot (n / y) \qquad [6.14]$$

in which y is production, n is the quantity of labour employed and their relation is constant.

The profit share compatible with long-term labour market equilibrium depends on two factors that determine the equilibrium wage. Hence, assuming that z, the reserve wage, stays constant, the profit share will increase with the rise in the unemployment rate

$$\pi = \varphi(u) \qquad \text{with } \frac{\partial \pi}{\partial u} > 0$$

With a fixed coefficient production function and a constant rate of productive capacity utilisation, the accumulation rate and growth of employment will be equal. Hence:

$$\frac{\partial(1-u)}{(1-u)} = \frac{\partial k}{k} - \frac{\partial n}{n} = \varphi(u)$$

which is a stable dynamic system in which the unemployment rate converges towards a long-term equilibrium value interpreted by Skott as a sort of natural unemployment rate whereby some workers are involuntarily unemployed, thus forming the industrial reserve army needed to extract the effort required by the firm on the part of employees.

Following Solow (1990) the effort function may be hypothesised as asymmetric, i.e. workers increase their effort in proportion to the increase in real wages in the expansion phase of the cycle, but then, with a reduced unemployment rate during the expansion phase, they require and get a higher wage premium (as envisaged by equation [6.11]). If now workers do not compensate this wage rise with a corresponding increase in effort, as the probability of finding another job if they are fired is high insofar as the unemployment rate is lower than it was at the beginning of the expansion phase and the entrepreneurs, in turn, do not react to this behaviour by reducing wages as they fear that a return to previous wage levels may produce a greater fall in effort than the fall in wages. Thus, the expansion phase of the cycle also produces an increase in the wage share.

Behaviour of this kind not only gives rise to possible multiple equilibria, according to the "strategic games" played by firms and workers, but also to presumably long-term persistence of the economy outside the equilibrium, with possible hysteresis effects, which may produce somewhat variegated adjustment dynamics and long-run equilibria.

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